

## ROLE OF MATRIX METALLOPROTEINASES IN PRETERM BIRTH

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Premature labor (PL)  
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Despite significant advances in obstetrics and gynecology, the exact mechanisms contributing to the premature onset of labor are still not fully understood. One of the factors influencing PL is matrix metalloproteinases (MMPs) — enzymes involved in the breakdown of extracellular matrix components, which are crucial for the normal preparation of the uterus and cervix for labor.

**INTRODUCTION.** Premature labor (PL) remains one of the leading causes of perinatal morbidity and mortality worldwide. Despite significant advances in obstetrics and gynecology, the exact mechanisms contributing to the premature onset of labor are still not fully understood. One of the factors influencing PL is matrix metalloproteinases (MMPs) — enzymes involved in the breakdown of extracellular matrix components, which are crucial for the normal preparation of the uterus and cervix for labor. Changes in MMP activity can contribute to the premature ripening of the cervix and its early dilation, which in turn may lead to premature labor. This paper aims to analyze the role of MMPs in the process of premature labor and their potential impact on the cervix structure.

### 1. Matrix Metalloproteinases: General Characteristics and Their Role in Pregnancy Physiology

Matrix metalloproteinases (MMPs) are enzymes that catalyze the breakdown of components of the extracellular matrix, such as collagen, elastin, fibronectin, and other structural proteins. These enzymes play an important role in physiological processes associated with tissue development and remodeling, including trophoblast invasion, blood vessel development, and the remodeling of the uterus and cervix during labor preparation.

Under normal conditions during pregnancy, MMP activity is regulated by various hormones, such as progesterone, estrogen, and inflammatory mediators, including interleukins. MMPs are activated in response to various stimuli, including mechanical stretching of uterine tissues, inflammatory processes, and hormonal changes occurring prior to labor. It is important to note that, during the early stages of pregnancy, MMP activity is low, preventing premature breakdown of connective tissues in the uterus. However, as pregnancy progresses, MMP activation increases, which is necessary for the normal process of labor, including the softening and dilation of the cervix.

## **2. MMPs and Their Role in Cervical Ripening**

One of the key aspects of labor is cervical ripening, which refers to changes in the cervix structure that facilitate dilation during labor. This process involves the breakdown of collagen fibers, an increase in tissue elasticity, and the preparation of the cervix for expansion. MMPs play a vital role in this process by facilitating the remodeling of the extracellular matrix in the cervix, promoting its softening. MMP activity in the cervix increases in the later stages of pregnancy, contributing to the breakdown of collagen and increased hydration of tissues. These changes help the cervix become more elastic and pliable, allowing it to open during labor. Throughout pregnancy, MMP activity is regulated by hormonal changes, particularly the increase in estrogen levels and the decrease in progesterone levels. However, in the case of premature labor, when the cervix begins to change before the term, MMP activity can be disrupted, leading to premature softening and dilation of the cervix.

## **3. MMPs in the Context of Premature Labor**

Premature labor is often associated with abnormal changes in the cervix, such as premature softening and the opening of the cervical canal. One of the key factors that may influence the onset of these processes is changes in MMP activity. Several studies have shown that women who deliver prematurely exhibit increased MMP activity in the cervix and other uterine tissues, which may be related to premature destruction of connective tissues and accelerated cervical ripening.

There are several mechanisms by which elevated MMP activity may contribute to premature labor. One of

them is the increased level of pro-inflammatory cytokines, such as interleukin-1 (IL-1) and tumor necrosis factor (TNF- $\alpha$ ), which stimulate the production of MMPs. These cytokines can increase MMP activity in cervical tissues, leading to premature collagen breakdown and enhanced elasticity of the cervix. Consequently, this promotes early cervical dilation and the initiation of labor.

#### 4. Diagnostics and Therapeutic Approaches

Early detection of increased MMP activity and predicting the risk of premature labor may play an essential role in preventing this condition. Currently, methods are being developed to monitor MMP activity in pregnant women. For instance, using markers such as MMP-9 levels and their inhibitors in serum or cervical secretions may be useful for diagnosing the risk of premature labor. Studies show that elevated MMP-9 levels in cervical mucus are associated with an increased likelihood of premature labor, especially when combined with other risk factors such as infections or multiple pregnancies.

An important aspect is also the development of therapeutic strategies aimed at inhibiting MMP activity to prevent premature cervical ripening. Some studies have shown that the use of drugs that block MMP activity or increase the levels of tissue inhibitors of metalloproteinases (TIMPs) can reduce the risk of premature labor.

**Conclusion:** Matrix metalloproteinases (MMPs) play a key role in the process of labor, including the softening of the cervix and its preparation for dilation. However, increased MMP activity can lead to premature cervical softening, which is a significant factor contributing to premature labor. Understanding the mechanisms of MMP activation and their role in the pathological process of premature labor may open new opportunities for diagnosis and treatment. The development of methods for controlling MMP activity and using therapeutic agents aimed at their inhibition holds promise for preventing premature labor and improving outcomes for both mother and child.

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